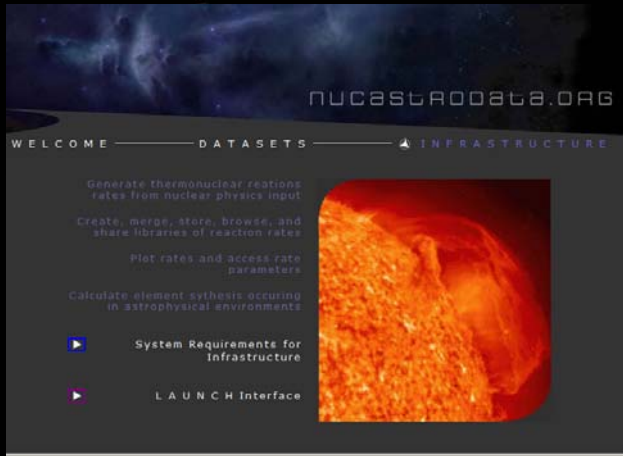


Recent Activities & Initiatives in the ORNL Nuclear Data Program

Caroline Nesaraja, Michael Smith
ORNL Physics Division



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Activities

Nuclear Structure Data

- Actinide **A-chain** Evaluations
- Nuclear Structure Database Development - linking Radware and **ENSDF**

Nuclear Astrophysics Data

- **Evaluation** of Reactions critical for Stellar Explosions
 - couple research and data activities
- Expand functionality of the **Computational Infrastructure** for Nuclear Astrophysics
 - attract young scientist & students for summer/ semester projects

Actinide Evaluations

Murray Martin & Caroline Nesaraja

Ensures that **ORNL** will continue its long history of excellence in Structure Evaluations

Responsibility: Actinide Evaluations **A=241 – 249**

Progress FY05

A=241 (completed and is at BNL for publication)

A=208 (in progress and to be completed at the end of November)

A= 245 (begin in November)

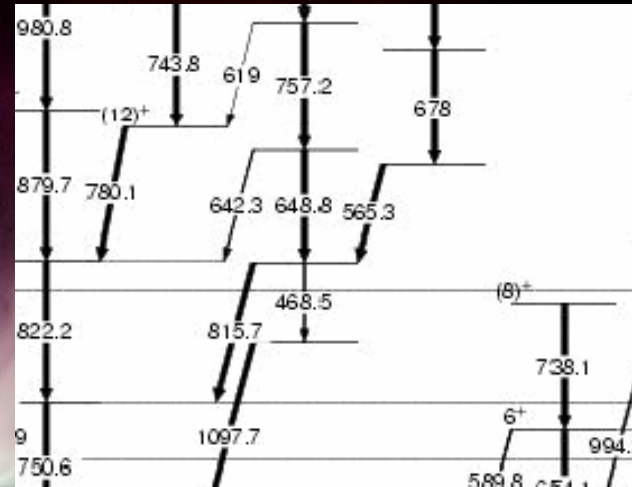
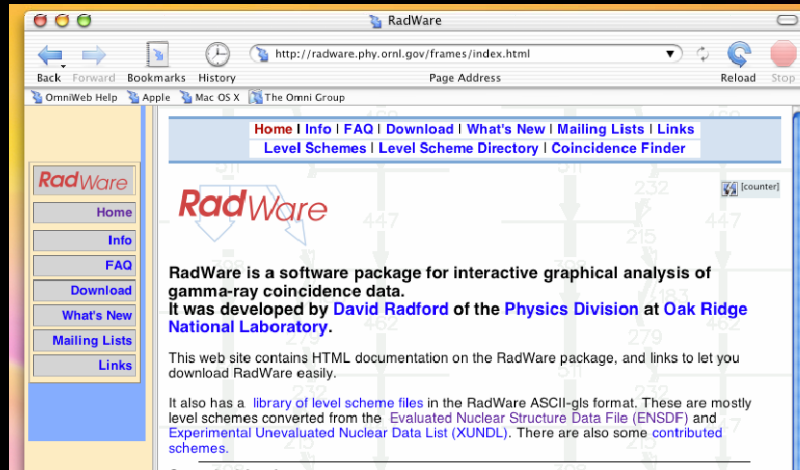
Training

- Caroline had attended the **Workshop on Nuclear Structure & Decay Data: Theory & Evaluation at Trieste, Italy 2005**
- Murray will be training Caroline to do evaluations on **A= 245**

Element	Mass Number (A)	Half-life
Bk	235	4.00 Y
Bk	236	3.70 Y
Bk	237	3.80 Y
Bk	238	1.80 Y
Bk	239	3.30 Y
Bk	240	1.20 Y
Bk	241	1.80 Y
Bk	242	1.20 Y
Bk	243	4.50 Y
Bk	244	1.20 Y
Bk	245	1.20 Y
Bk	246	1.20 Y
Bk	247	1.20 Y
Bk	248	1.20 Y
Bk	249	1.20 Y
Bk	250	1.20 Y
Bk	251	1.20 Y
Bk	252	1.20 Y
Bk	253	1.20 Y
Bk	254	1.20 Y
Bk	255	1.20 Y
Bk	256	1.20 Y
Bk	257	1.20 Y
Bk	258	1.20 Y
Bk	259	1.20 Y
Bk	260	1.20 Y
Cm	235	8.30 Y
Cm	236	9.70 Y
Cm	237	15.0 Y
Cm	238	29.1 Y
Cm	239	90.0 Y
Cm	240	27.0 Y
Cm	241	33.0 Y
Cm	242	162.0 Y
Cm	243	90.0 Y
Cm	244	1.80 Y
Cm	245	83.0 Y
Cm	246	1.10 Y
Cm	247	1.50 Y
Cm	248	8.10 Y
Cm	249	1.60 Y
Cm	250	1.60 Y
Cm	251	1.60 Y
Cm	252	1.60 Y
Cm	253	1.60 Y
Cm	254	1.60 Y
Cm	255	1.60 Y
Cm	256	1.60 Y
Cm	257	1.60 Y
Cm	258	1.60 Y
Cm	259	1.60 Y
Cm	260	1.60 Y
Am	235	10.0 Y
Am	236	10.0 Y
Am	237	10.0 Y
Am	238	10.0 Y
Am	239	10.0 Y
Am	240	10.0 Y
Am	241	10.0 Y
Am	242	10.0 Y
Am	243	10.0 Y
Am	244	10.0 Y
Am	245	10.0 Y
Am	246	10.0 Y
Am	247	10.0 Y
Am	248	10.0 Y
Am	249	10.0 Y
Am	250	10.0 Y
Am	251	10.0 Y
Am	252	10.0 Y
Am	253	10.0 Y
Am	254	10.0 Y
Am	255	10.0 Y
Am	256	10.0 Y
Am	257	10.0 Y
Am	258	10.0 Y
Am	259	10.0 Y
Am	260	10.0 Y
Pu	232	3.80 Y
Pu	233	4.30 Y
Pu	234	8.00 Y
Pu	235	13.3 Y
Pu	236	2.80 Y
Pu	237	4.70 Y
Pu	238	261.0 Y
Pu	239	65.8 Y
Pu	240	14.3 Y
Pu	241	13.2 Y
Pu	242	370.0 Y
Pu	243	4.90 Y
Pu	244	8.00 Y
Pu	245	1.60 Y
Pu	246	1.60 Y
Pu	247	1.60 Y
Np	231	3.80 Y
Np	232	2.10 Y
Np	233	1.40 Y
Np	234	2.10 Y
Np	235	3.90 Y
Np	236	1.50 Y
Np	237	2.10 Y
Np	238	2.10 Y
Np	239	2.10 Y
Np	240	2.10 Y
Np	241	2.10 Y
Np	242	2.10 Y
Np	243	2.10 Y
Np	244	2.10 Y
U	230	4.50 Y
U	231	4.50 Y
U	232	14.0 Y
U	233	15.0 Y
U	234	24.5 Y
U	235	70.4 Y
U	236	23.4 Y
U	237	4.70 Y
U	238	4.40 Y
U	239	23.4 Y
U	240	14.0 Y
U	241	4.50 Y
U	242	1.60 Y
Pa	229	1.30 Y
Pa	230	17.0 Y
Pa	231	3.30 Y
Pa	232	1.30 Y
Pa	233	1.30 Y
Pa	234	1.30 Y
Pa	235	1.30 Y
Pa	236	1.30 Y
Pa	237	1.30 Y
Pa	238	1.30 Y
Pa	239	1.30 Y
Pa	240	1.30 Y
Th	228	1.90 Y
Th	229	7.90 Y
Th	230	14.0 Y
Th	231	25.5 Y
Th	232	14.0 Y
Th	233	1.30 Y
Th	234	1.30 Y
Th	235	1.30 Y
Th	236	1.30 Y
Th	237	1.30 Y
Th	238	1.30 Y
Ac	227	21.8 Y
Ac	228	6.00 Y
Ac	229	9.00 Y
Ac	230	13.0 Y
Ac	231	19.0 Y
Ac	232	1.30 Y
Ac	233	1.30 Y
Ac	234	1.30 Y
Ac	235	1.30 Y
Ac	236	1.30 Y
Ra	226	1600 Y
Ra	227	4.20 Y
Ra	228	5.70 Y
Ra	229	15.0 Y
Ra	230	1600 Y
Ra	231	15.0 Y
Ra	232	1.30 Y
Fr	225	4.80 Y
Fr	227	24.7 Y
Rn	224	3.80 Y
Rn	225	4.40 Y
Rn	226	10.6 Y
Rn	228	6.40 Y

Nuclear Structure Databases: ENSDF and RADWARE

D. Radford



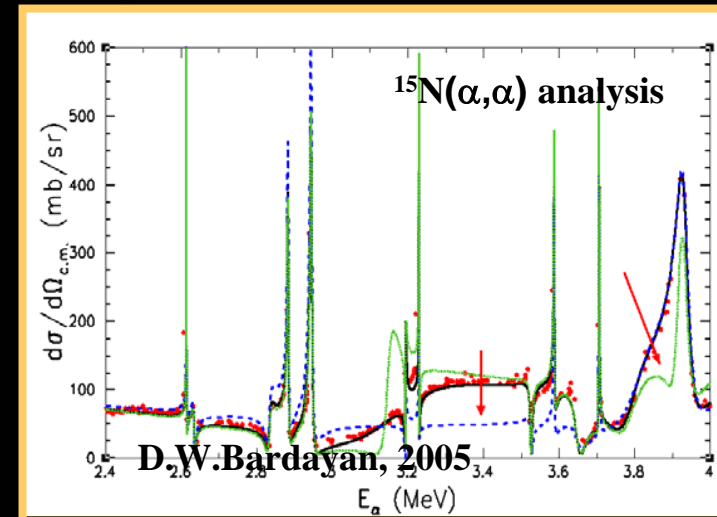
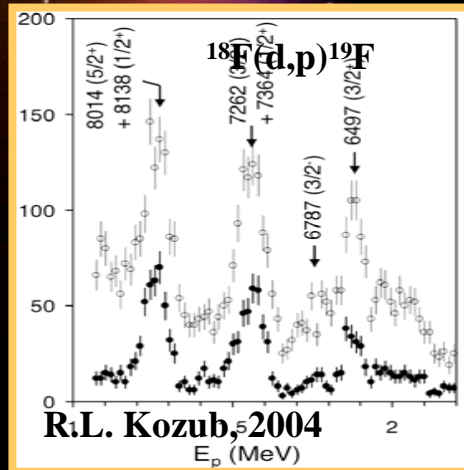
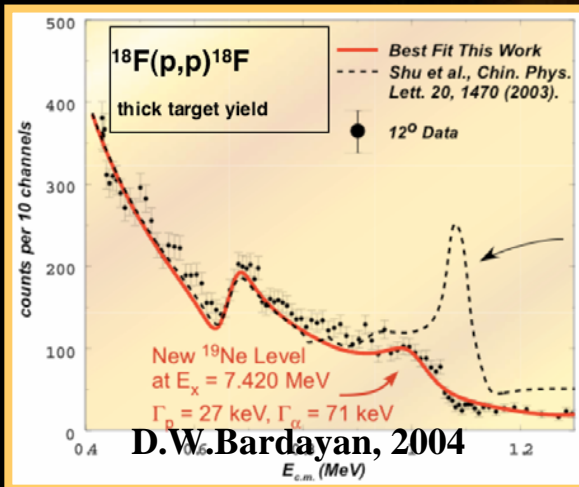
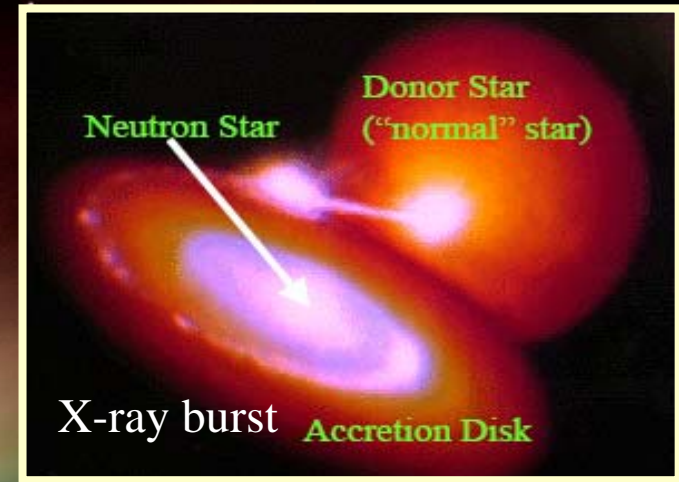
- **ENSDF** at NNDC: World's Best Nuclear Structure Data Base
- **RADWARE**: World's Best Data Analysis Tool
in High Spin Nuclear Structure Physics
- **Combine** by converting ENSDF & XUNDL files into RADWARE format
radware.phy.ornl.gov
- Users can **display** & **manipulate datasets**, incorporate ENSDF information into **ongoing analyses** of experimental data, perform **advance searches** (coincidence γ rays), generate high quality output
- Current plans are to **maintain** the website with regular ENSDF uploads

Nuclear Astrophysics Data

$^{18}\text{F}(p,\alpha)^{15}\text{O}$ & $^{18}\text{F}(p,\gamma)^{19}\text{Ne}$

Motivation

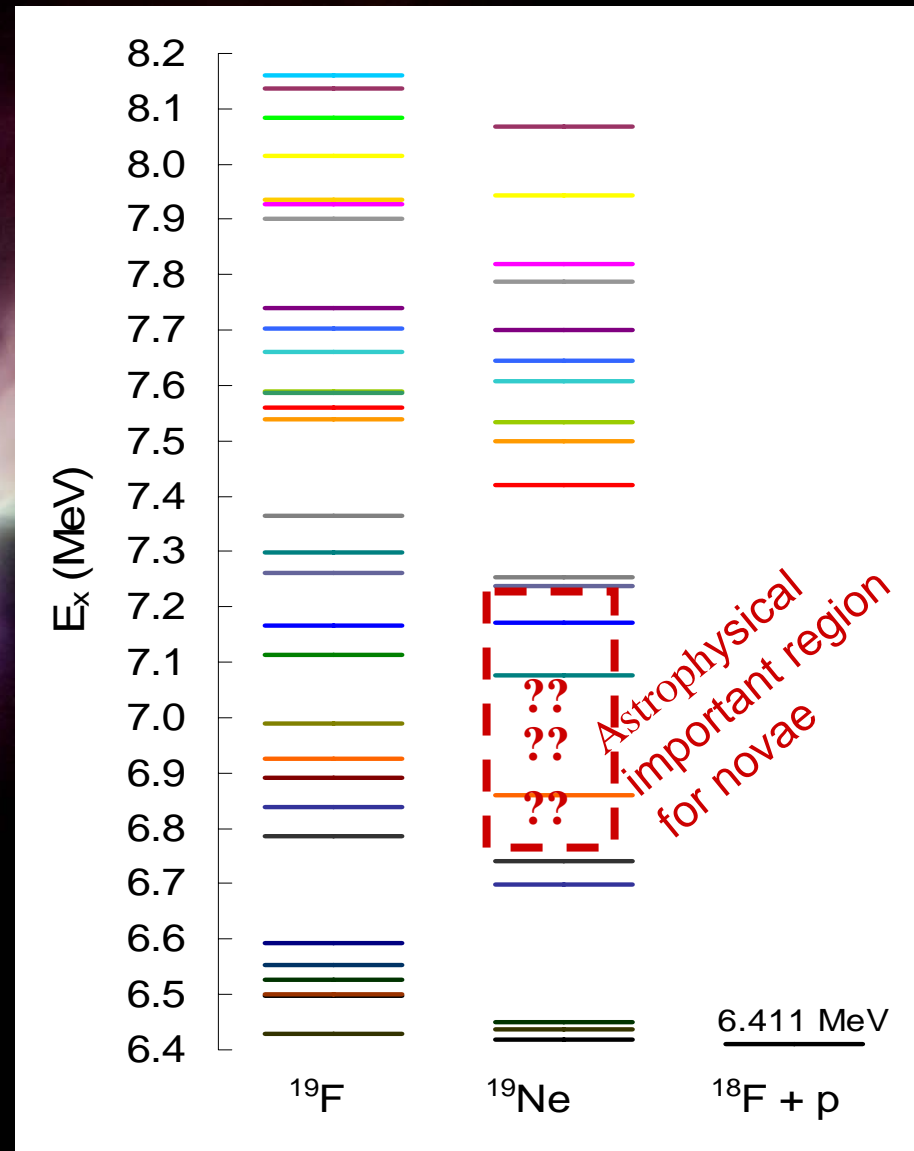
- Important for novae & X-ray bursts
- Many experiments performed with radioactive beams require new evaluations
- New evaluation of ^{19}F levels from the legacy of $^{15}\text{N}(\alpha,\alpha)$ data

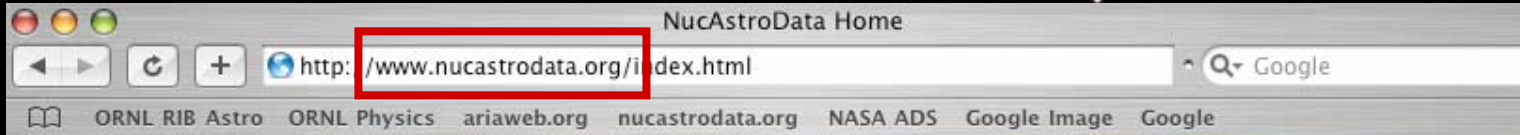


$^{18}\text{F} + \text{p}$ evaluation task

Detailed nuclear structure information for ^{19}Ne
~ 30 levels between $E_x = 6.411 - 8.100$ MeV

- **Excitation energies** for missing levels
(scaled using Thomas-Ehrman shift calculations)
- **spin and parity** assignments
(angular momentum transfer or J^π of mirror nuclei)
- **Partial gamma widths**, Γ_γ
(corrected for phase space & reduced transition probability for Γ_γ of mirror nuclei)
- **Partial proton widths**, Γ_p
(spectroscopic factor and using a diffuse surface potential or by direct measurements)
- **Partial alpha widths** Γ_α
(assuming analog states have same reduced widths & correcting for the Coulomb barrier penetration)





- **processing & dissemination** work is needed along with evaluations
- **website** for Nuclear Astrophysics Data helps facilitate this
- provides **convenient entry point** for astrophysics data on the web
- **categorizes & hyperlinks** all available datasets

NUCASTRODATA.ORG

WELCOME — DATASETS — INFRASTRUCTURE



NUCASTRODATA.ORG
is your WWW resource for creating, accessing, and managing nuclear physics information for astrophysics studies

DATASETS
Hyperlinks to all online nuclear datasets, categorized and continually updated

INFRASTRUCTURE
A suite of codes with a graphical user interface enabling researchers to calculate thermonuclear reaction rates from nuclear physics input, put them into rate libraries, browse and plot the rates, and manage and share rate libraries with the community

- **site also hosts the computational infrastructure ...**

suite of FORTRAN codes to ease the processing of nuclear results into astrophysics models,

NUCASTRODATA.ORG

WELCOME



DATASETS

INFRASTRUCTURE

Reaction Rate Collections with Combined Experimental & Theoretical Rates

Evaluated Experimental Reaction Rate Collections

Theoretical Reaction Rates

Weak Reaction Rates

S-factors

Experimental & Evaluated Cross Sections

Theoretical Cross Sections

Plots of Nuclear Reaction Rates & Cross Sections

Nuclear Structure

NACRE Charged Particle-Induced Reaction Rate Library 1999 - Angulo et al., NACRE Collab. [ULB]

Charged Particle-Induced Reaction Rates for $A = 20 - 40$ - Iliadis et al. 2001, UNC Chapel Hill [UNC]

REACLIB Charged Particle-Induced Reaction Rate Updates 1999 - Lugaro, Cambridge [Cambridge]

Charged Particle-Induced Reaction Rates - Caughlan and Fowler 1988, Caltech [ORNL]

Light Charged Particle-Induced Reaction Rates - Hale et al., LANL [LANL]

categories

datasets

Computational Infrastructure for Nuclear Astrophysics

With a few mouse clicks, the suite enables users to:

- **store, renormalize, extrapolate** cross sections & s-factors
- **calculate** reaction rates from cross sections & s-factors
- **parameterize** reaction rates
- **plot & modify** reaction rates
- **insert** rates into new or existing libraries
- **create, store, modify, document, merge, & share libraries**
- **run, store, compare, & visualize** element synthesis calculations

Astrophysics online computer system - C.D. Nesaraja

Thursday: Common Session - Modeling &

Astrophysics

Computational Infrastructure for Nuclear Astrophysics



features added since last UNSDP meeting

- **compare and visualize** difference between theoretical & measured masses, separation energies, and Q-values
- **view, add, and post** comments to a reaction
- **run** element synthesis calculation, **visualize & create movies** of
 - reaction fluxes
 - abundance & time derivatives of abundance

Registered Users

Institutes: 39

Countries: 15

Element Synthesis Animator: Abundance

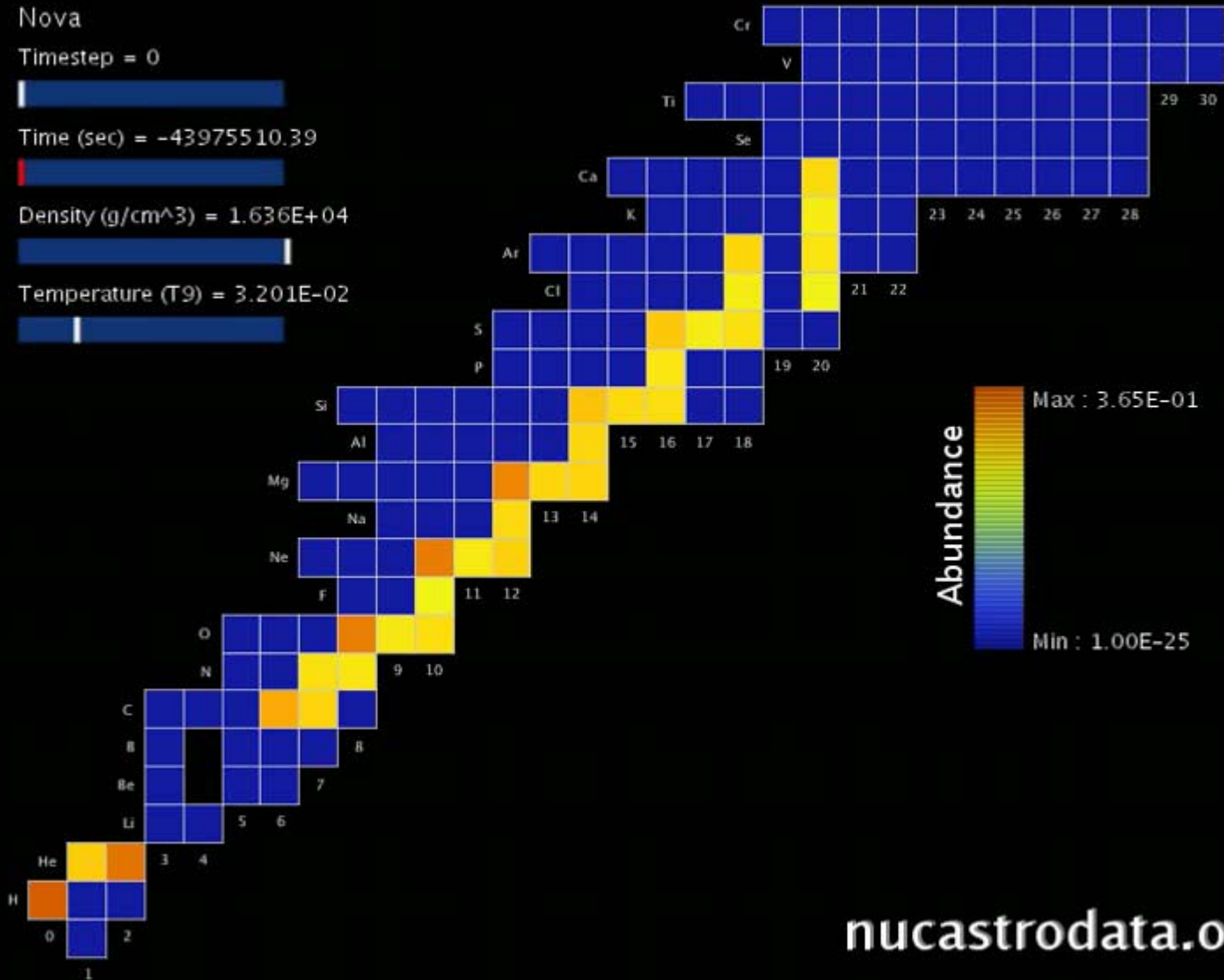
Nova

Timestep = 0

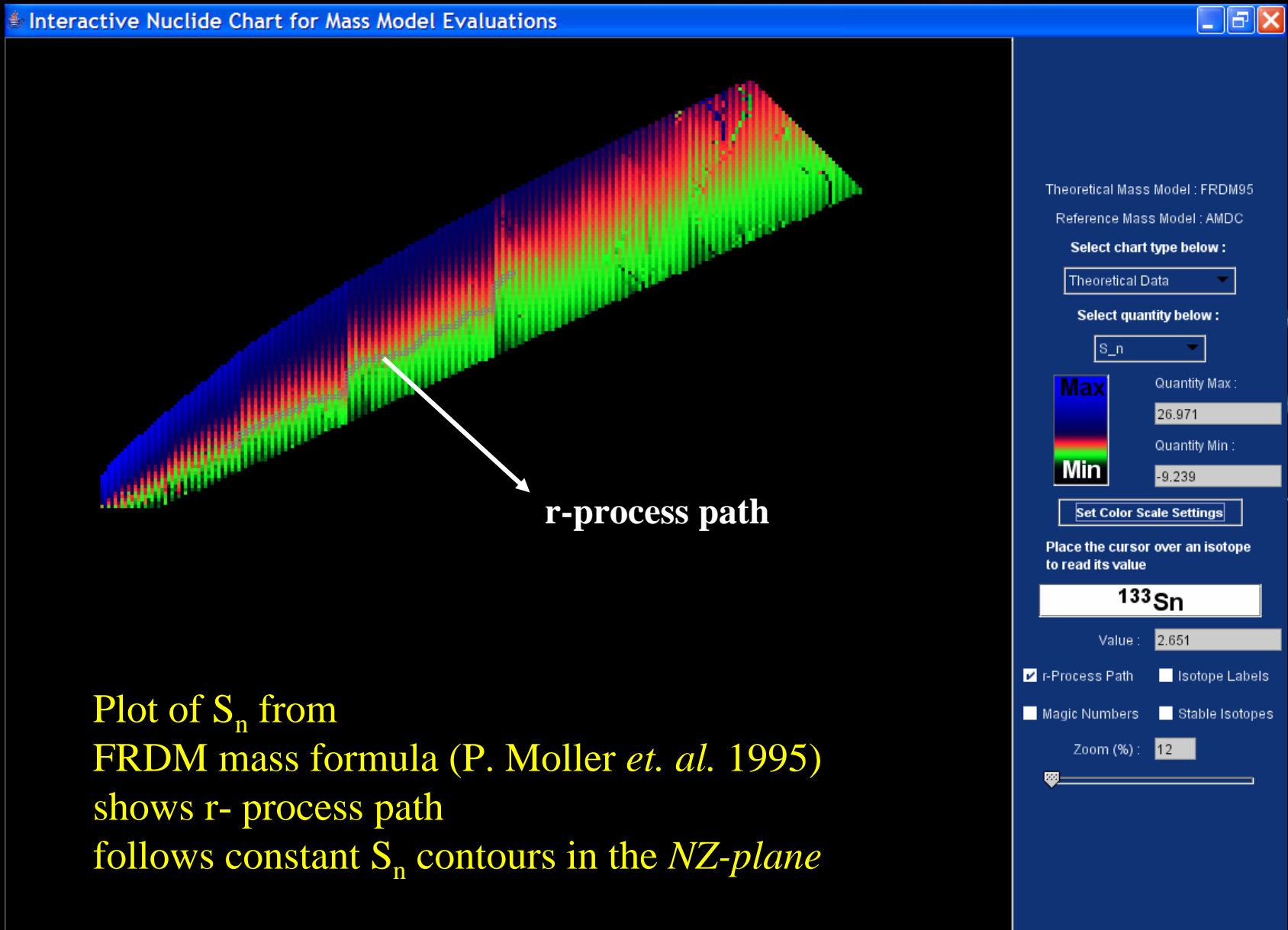
Time (sec) = -43975510.39

Density (g/cm³) = 1.636E+04

Temperature (T9) = 3.201E-02



Screenshot: Mass Model Evaluator



Screenshot: Rate Commentor

The screenshot displays the 'Rate Commentor' application window. On the left, a tree view shows a folder structure: 'p + 18F --> 4He + 150 (0)' containing 'Distinct #1 (0)', 'Distinct #2 (2)' (with a sub-item 'ORNL Canonical-2000-B'), and 'Distinct #3 (0)'. Below this, text indicates 'Public Libraries are BLUE.', 'Shared Libraries are GREEN.', and 'User Libraries are RED.'.

Subject	User	Folder	Date
test comment on distinct r...	Michael Smith	p + 18F --> 4He + 150\Dis...	2005-05-24 11:49:02
Re: test comment on disti...	Michael Smith	p + 18F --> 4He + 150\Dis...	2005-05-24 11:55:24
test comment	Michael Smith	p + 18F --> 4He + 150\Dis...	2005-05-24 11:47:17

The main content area shows details for the selected comment: 'Subject: test comment', 'Posted by: Michael Smith', and 'Date: 2005-05-24 11:47:17'. Below this, the comment text reads 'test comment 1'.

At the bottom, a control panel contains several buttons: 'Post New Comment' (circled in red), 'Reply to Comment' (circled in orange), 'Export Comments', 'Copy Comments to Clipboard', 'Help on This Interface', '< Back', 'Close Rate Commentor', and 'Rate Library Manager'. Two red arrows point from the 'Post New Comment' and 'Reply to Comment' buttons to the text 'Add new comments of your own' and 'Reply to comments' respectively.

Sharing comments helps build the community's knowledge of these reactions, and also enables consensus to be reached on difficult issues.

Personnel (FY05)

Nuclear Astrophysics Data

Michael Smith	Staff	Evaluations
Jeff Blackmon	Staff	Evaluations
Caroline Nesaraja	Postdoc	Evaluations
* Zhanwen Ma	Grad Student	Evaluations
Nengchuan Shu	Collaborator	Evaluations
* Hiroyuki Koura	Collaborator	Mass Models (JAERI)
Andy Chae	Grad Student	Programming
Eric Lingerfelt	Subcontractor	Programming
Jason Scott	Subcontractor	Programming
* Carlos Ortiz	Undergrad	Programming (summer 05)
* Rick Carroll	Undergrad	Programming (summer 05)
* Richard Meyer	Consultant	Program Development

Nuclear Structure Data

Murray Martin	Subcontractor	Evaluations
* David Radford	Staff	Evaluations

* can no longer be supported in FY06 due to budget cuts

Future Plans

- **Evaluations:**
 - Actinide A-chain
 - Reactions critical for Stellar Explosions studies
- continue expansion of extremely successful **Computational Infrastructure for Nuclear Astrophysics** suite of codes
- aggressively recruit young scientist & students for summer projects
- vigorously seek additional funds to offset 20 % budget cut in FY06

Summary

- **Actinide Evaluations** will continue with focus on **A=241-249**
- Reactions needed to understand **stellar explosions** (novae & X-ray bursts) are being **evaluated**
- Continue improving and adding new features to **the Computational Infrastructure** to help users to evaluate & visualize latest experimental results, process & manipulate them into formats for astrophysical models and to run & visualize simulation